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### Bank Capital and Bank Structure: A Comparative Analysis of the US, UK and Canada

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BANK CAPITAL AND BANK STRUCTURE:  
A COMPARATIVE ANALYSIS OF THE US, UK AND CANADA

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## ABSTRACT

This study investigates a 100-year history of the asset-risk and capital structure choices of publicly-traded banks located in the UK, Canada and the U.S. These three countries were chosen because of their diverse regulatory and banking structures, while sharing common legal and cultural institutions. For example, the U.S. has historically fostered small banks, and a regulatory system split between national and state regulators. In contrast, Canada has sought financial-sector stability through a small number of large nationally-branched banks that have acted cooperatively with bank rescues during periods of crisis, prior to the presence of their central bank. Finally, the UK established an early tradition of internationally-diversified banking assets and developed a "life-boat" support system orchestrated by the Bank of England. These differences in bank structures and regulatory framework form the basis of our analysis.

The study documents the secular decline in bank capital ratios that has occurred in each country over the past 100 years, and tests various hypotheses concerning how differences in bank risk-taking, the value of bank charters, bank consolidation and extent of safety net guarantees impact capital structure choices. Several broad conclusions follow from the study's results. First, stronger safety net guarantees, such as lender-of-last-resort and liability guarantees, appear to account for much of the historical decline in capital levels, and in particular that component of capital that is independent of a bank's choice of asset risk-taking. We hypothesize that absent strong safety-net guarantees banks were compelled to hold "reserve" levels of capital that served to absorb unexpected capital losses, e.g., those incurred during a bank panic. Interestingly, the study finds that risk-sensitive capital levels in the 1990s are comparable to those found in the 1890s across all three countries, despite considerable differences in bank system structure.

Second, despite significant increases in the provision of safety-net guarantees within each country, the study finds that bank asset-risk choices in the 1990s are comparable to those observed in earlier decades. In contrast, the study documents dramatic increases in bank equity volatilities across the three countries, with approximately a 10-fold increase in equity volatilities over the 100-year period. The increased equity volatility appears to be mostly related to the decline in bank capital ratios (increase in leverage), rather than to changes in asset risk choices. Therefore, the study fails to link the provision of government guarantees to moral-hazard-driven increases in bank risk taking, despite the regulatory-regime transitions over the study period from relatively unregulated to more highly-regulated banking structures.

## Introduction

This study investigates the secular changes that have occurred over the past 100 years with the banking systems of Canada, the UK, and the U.S. While these three countries were chosen for their common legal and cultural backgrounds, each country has evolved along distinct regulatory pathways. For example, the U.S. historically combined a weak safety net with restrictions on branching and other activities that resulted in a banking system prone to disruptive banking panics and bank failures. By contrast, both Canada and the UK evolved consolidated and highly-branched banking systems that proved resilient to economic crises such as those during the 1930s. Canada and the UK also developed interbank cooperation mechanisms, e.g., the "life boat" system of the UK, to stem contagion effects and buffer their financial systems.

One focus of our study is to relate the evolution of bank capital levels to the regulatory and support structures in place at the time. Several hypotheses have been advanced to explain the historical role of bank capital. For example, Berger, Herring and Szego (1995) relate U.S. bank capital declines to the moral-hazard incentives put in place with the implementation of deposit insurance under the Banking Acts of 1933 and 1935.

As well, Calomiris and Kahn (1991) hypothesize that high capital levels and demandable debt served to minimize agency conflicts between bank insiders and liability-holders. Similarly, Gorton and Pennacchi (1990) argue that high capital levels increase the liquidity of short-term bank debt, which allows

informationally-disadvantaged "liquidity" traders to transact in a safe medium. However, since risk cannot be perfectly eliminated, a role is created for government guarantees to insure the liquidity of bank deposits.

Calomiris and Wilson (1997) analyze the risk structure of bank capital decisions and report empirical support for the Gorton and Pennacchi style arguments. Using U.S. bank data over the 1920-30s, they find that "bank runs" during the 1930s were in response to sharp increases in bank asset risk that coincided with bank capital losses. The paper also finds that banks compensated for capital losses by liquidating loans and increasing cash and near-cash levels, resulting in a lending "capital crunch" during the 1930s.

The design of our study is to use cross-country bank-structure differences to help unravel regulatory influences on banks' choice of capital and asset risk levels. To this end, bank-specific balance sheet and bank stock price data are collected from historical sources. Balance sheet data are collected annually. Bank stock price data is monthly for Canada and the UK and weekly for the U.S. These data allow us to construct book and market capital ratios, equity and asset volatility estimates and measures of bank charter value.

Our study finds that a bank's capital structure choice can usefully be viewed in terms of two components, one reflecting expected losses and a second component that protects against sudden (panic-induced) changes in risk. With the first component banks adjust their capital positions to reflect bank-specific risk

factors, such as asset risk and charter value. We find evidence of the risk-sensitivity of capital across all three national banking systems. These results are similar to those reported by Calomiris and Wilson (1997) for the U.S. in the 1920s and 1930s.

The second component of capital is termed systemic (non bank-specific) capital, in that its level appears to be unrelated to levels of bank-specific risk factors. This capital source may have served several roles historically, such as providing a reserve fund of capital to protect against systemic shocks to the banking sector, e.g., the 1929 stock market crash. In addition, high systemic capital levels served as insurance to protect risk-averse bank creditors and "liquidity traders," during periods when liquidity may have been subject to rationing among banks within a market.<sup>1</sup> In support of this notion, we find that high capital levels were associated with regulatory regimes displaying weak safety net and other bank-support or guarantee systems. Moreover for the entire 100-year period analyzed, we find that most of the secular decline in bank capital can be attributed to declines in this systemic-shock capital component. Alternatively, we show that bank capital ratios appear to have been as asset-risk sensitive in the 1980s as those in the 1890s in each of the three countries.

The plan of the paper is as follows. In Section 2, the major regulatory features of each country are briefly summarized, particularly with respect to bank regulation, bank structure and

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<sup>1</sup>Indeed, the Federal Reserve System was founded under the Banking Act of 1913 to provide liquidity during such times.

elements of the safety net in each country. In Section 3, the data sources are described. Results are discussed in section 4, including an analysis of bank failure and depositor loss rates that help characterize the development of the safety net in each country. Section 6 discusses our conclusions.

## **II. Regulatory Background**

In this section we present a "bare-bones" overview of the banking structures and associated regulatory frameworks in the U.S., Canada and the UK. In particular, we focus on three aspects, namely (i) the development of bank regulation and supervision, (ii) restrictions on the ability of banks to expand geographically through branching or to consolidate with other banks, and (iii) the stage of development of regulatory "safety net" provisions, including lender-of-last-resort and bank liability guarantees, such as deposit insurance.

### **II.A. U.S. historical regulatory structure**

The U.S. banking structure is well known [see Baer and Mote, 1994]. Before 1863, bank chartering and regulatory authority resided exclusively with the states. Early state bank legislation included the "free-banking" statutes of the 1830-40s, which partially deregulated bank chartering. Double liability of bank shareholders was common among states at this time. Other early state bank legislation included reporting, reserve and minimum capital requirements. New York state set up the earliest



supervisory system with the Safety Fund Act of 1829 and a permanent banking department in 1851. Other states followed suit.

Historically, state banks were generally restricted by state regulators from branching interstate. The early view was that branching was antithetical to "local money power," and so in 1910 there were only nine national banks with twelve branches (Klebaner, 1990, p. 70). In 1927, the McFadden Act extended state branching restrictions to nationally-chartered banks. These restrictions mostly persisted until the 1980s with the emergence of regional banking pacts that authorized out-of-state banks to acquire banks in-state. By 1996, all states but Hawaii had passed such legislation. In 1994, Congress passed the Riegle-Neal Act, under which out-of-state banks acquired through mergers and acquisitions could be converted into branches beginning in June 1997.

Creation of a central bank authority lagged substantially behind the establishment of regulatory and supervisory authorities. However, limited central bank functions were provided through clearinghouse loan certificates and correspondent-banking relationships. Creation of the Federal Reserve System occurred in 1913 "to furnish an elastic currency" and "to afford means of rediscounting commercial paper." Federal deposit insurance followed under the Banking Acts of 1933 and 1935. Related legislation included interest rate ceilings on deposits under Reg Q to limit competition among banks for depositors and to restrict payment of interest on interbank deposits, which competed with the Federal Reserve System for reserve holdings.

More recent regulatory changes include the "national treatment" imposed on foreign banks entering the U.S. after 1978 under the International Banking Act. Pressure was exerted on Canada to reciprocate and likewise grant U.S. banks national treatment. Finally, the 1933 Glass-Steagall restrictions on investment banking powers of commercial banks weakened with the establishment of Section 20 subsidiaries in 1987. Initial limits on these activities were set at 5%, but later increased to 25% of the gross revenues generated by the Section 20 subsidiary.

#### **II.B. Canadian regulatory background**

In contrast to the U.S., bank regulatory authority has resided primarily with federal authority since the British North American Act of 1867, under which Canada gained independence. Centralized regulatory authority also came to be matched by concentration of banking assets. Starting with a wave of consolidations in the late 1800s, the Canadian banking system has been dominated by a few large nationally branched banks.

From a historic high of 51 banks in 1874, chartered-bank numbers declined to 35 in 1900 and to 11 in 1925, mostly through bank mergers. By 1966, the 5 largest Canadian banks held 90% of domestic bank assets (Bordo et al (1995)). Concentration of banking assets has been linked to banking-sector stability. In particular, during the 1920s and 1930s, when bank failure rates were extremely high in the U.S., Canada experienced only one, namely Home Bank in 1923.

Regulatory and supervisory bank powers reside with the Office of the Superintendent of Financial Institutions, which was created in 1987 to succeed previous authority which resided with both the Department of Insurance and the Inspector General of Banks. Bank supervision inspections were instituted in 1924 following failure of the Home Bank. However, by 1980 there were only seven inspectors, and in general regulation and supervision in Canada has been less severe than in the U.S. (Bordo, Redish and Rockoff, 1995).

Formal central-bank guarantees began with creation of the Bank of Canada in 1935. However, prior to 1935 some central bank services existed. For example, the government supplied liquidity during the Panic of 1907, even though formal powers to do so were not granted until the 1914 Finance Act gave the Finance Ministry formal lender-of-last-resort powers (See Shearer, Chant and Bond (1995)). Interbank lending and clearinghouse services were also mutually provided among chartered banks.

Provision of national deposit insurance occurred with the 1967 revisions to the Canadian Banking Act which created the Canadian Deposit Insurance Corporation. Canadian deposit insurance legislation was in response to the failure of several trust companies. However, implicit deposit insurance and a too-big-to-fail (TBTF) policy were in place in Canada at least as early as the 1930s. Beckhart (1929) reports that forced mergers served to insure the banking system against outright bank failures, resulting in essentially a 100% deposit guarantee. The Canadian government also

provided "generous" liquidity assistance to banks during the early 1930s (Kryzanowski and Roberts, 1994).

Canadian deposit insurance was modeled on the U.S. system, with similar deposit insurance ceilings (C\$60,000) and non-risk based premiums (10 bp per Canadian dollar of insurable deposits) until recently. Savings and checking accounts, term deposits and deposit receipts are covered. Membership is mandatory for all chartered banks, and optional for other depository institutions, such as trust companies. Deposit insurance increased the competitiveness of the deposit market and decreased the advantage of large banks, since small institutions could now offer risk-free deposits.

Banking in Canada became increasingly competitive by the 1980s. The 1980 Bank Act revisions allowed trust companies access to check-clearing facilities, and allowed foreign bank entry for the first time. Nonetheless, the 5 largest Canadian banks continued to hold over 84% of domestic banking assets [see Shaffer (1993)]. More recently, the Bank Act of 1992 ended the separation between commercial banking and investment banking.

### **II.C. UK regulatory background**

In the late 1800s and early 1900s, the UK banking system evolved from a large number of regional banks to one dominated by nationally-branched clearing banks, plus a number of internationally-specialized "multinational" banks. Capie (1994) reports that in 1900 188 banks with 5922 branches existed, with the

5 largest banks holding 31% of UK deposits. By 1920, the number of UK banks had declined to 75 with 9,668 branches, and with the five largest "London" clearing banks holding 80% of deposits. Included in this number were the multinational banks that specialized in international banking, usually within a particular region, e.g., South America, Africa or Australasia. These were based in London to take advantage of the large British deposit base, and to gain access to equity capital through the London Stock Exchange (Jones, 1993).

British attitudes towards central banking and bank regulation before WW II can be described as "laissez-faire." There were few prudential bank regulations, and no restrictions on branching either nationally or internationally. Indeed, the Bank of England itself was formed in the 1690s as England's first (publicly-held) joint stock bank, to act as banker to the government. The Bank's role developed to include the issue and management of short-term government debt, conducting its own private discount business and providing a rediscount facilities to discount houses (Roberts, 1995).

The Bank's lender-of-last-resort obligation was to maintain the liquidity of the money market, but, as discussed by Capie (1995) this role did not involve bailing out failing institutions. However, the Bank did organize rescue or "lifeboat" funds, subscribed to by commercial banks and other London firms, as with the bailout of Barings Brothers in 1890. The Bank of England came under government control with the Bank of England Act of 1946.

Over the 1920-70 period, the Bank of England encouraged bank concentration by allowing large clearing banks to collude in setting interest rates on deposits, loans and in the London money market [see Griffiths (1973), Capie (1996)]. This cartelization of UK banking was viewed as supporting the Bank of England's approach to monetary targets in setting their Bank Rate as lender-of-last-resort. In the late 1970s and into the 1980s, the Bank of England began to liberalize its monetary policy approach, allowing greater competition among banks.

One exception to the relative stability of the British banking system was the "secondary banking" crisis that occurred in the early 1970s, as a result of concentrated lending by the so-called "secondary banks." This crisis revolved around approximately 30 small banks that specialized in making loans to the property sector. The banks were poorly regulated and borrowed much of their funds from UK clearing banks and the money market. Without support, virtually all of the secondary banks and some primary banks such as National Westminster Bank would also have failed. The Bank of England and clearing banks created an "ad hoc" lifeboat fund to rescue 26 secondary banks (Reid, 1982). Essentially, a "too-big-to-fail" policy existed that paralleled the Continental Illinois TBTF bailout in the U.S. in 1984. This stability was achieved in the absence of an explicit deposit insurance scheme.

One result of the secondary banking crisis was the establishment in 1982 of the UK deposit insurance scheme, administered by the Bank of England. The UK scheme differs from

that of Canada and the U.S. in the following ways. First, the fund has no permanent reserves, but rather levies size-related assessments against member banks in case of bank failure. Second, the existence of deposit insurance is not widely advertised. Third, deposit coverage is subject to an upfront deductible of 25% and a £20,000 coverage cap to impose risk-sharing losses on depositors. Finally, without permanent reserves the fund cannot carry out a TBTF policy. Instead TBTF action would come from the Bank of England and with clearinghouse bank support.

Another consequence of the secondary banking crisis was the creation of a (first-time) system of statutory bank supervision under the 1979 Banking Act. This followed creation of a Bank Supervision Department within the Bank of England in 1974.

Implicit (BOE-approved) barriers between commercial and investment banking existed in the UK until the "Big Bang" of 1986, which allowed domestic and foreign acquisition of UK merchant (investment) banks. Since then, virtually all small independent UK merchant banks have been acquired, e.g., by ING, Deutsche Bank and Barclays.

#### **II.D. Cross-country regulatory comparison**

The brief summary above underscores striking differences in the evolution of banking-sector structure and regulation in each country. The U.S. historically showed an aversion to the monopolization of banking assets, either in private or public hands, and attempted various devices to otherwise help stabilize

its crisis-prone banking sector. For example, the U.S. adopted significant bank regulation and supervisory authorities long before Canada or the UK, to instill safety and soundness in its limited-branching banking system. When these mechanisms proved inadequate, e.g., the banking panic in 1907, it then created a central bank in 1913 and a strengthened safety net with the adoption of federal deposit insurance in 1933.

In contrast, both Canada and the UK pursued branching and bank consolidations as avenues to financial-sector stability. By the 1920s banking was highly consolidated and highly branched in both countries. In contrast, regulation and supervision were minimally imposed during this earlier period.

Since WW II, all three countries have shown convergence in the structure of their banking sectors. Entry barriers to foreign bank competition have been relaxed, as have barriers between commercial and investment banking. Interest-rate cartelization (such as with regulation "Q" in the U.S.) has been reduced and greater competition introduced. In the U.S., interstate bank branching and acquisition restrictions have also been reduced.

### III. Data

Bank-specific annual balance sheet and weekly or monthly bank stock prices for each bank for the 100-year period: 1893-1992 were collected. For the UK, monthly stock prices and annual balance sheet data was taken from the UK Bankers' Magazine for the period 1893-1933. Post-1933, month-end stock prices were obtained from the



Financial Times and balance-sheet data were taken from Moody's Investment Manual. For Canada, monthly over-the-counter quotes for Canadian bank stocks were obtained from the Commercial and Financial Chronicle and balance-sheet data from Moody's Investment Manual and from The Statistical Yearbook of Canada.

Finally, for the U.S. the Commercial and Financial Chronicle reports bid and ask prices for a large sample of banks that cover the period 1893 onwards. During the pre-WW II period this sample consisted mostly of New York City metropolitan area banks and trust companies. These banks ranged in size from the large New York City money-center banks, such as National City Bank and Chase National Bank, to smaller borough and suburban banks, such as Bronx Borough Bank and Westchester Trust Company.

Balance sheet data for the sample of banks was collected from Rand McNally's Bankers Directory for the period before 1928. Thereafter, most data was drawn from Moody's Investment Manual, which began publication in 1928, and from the Compustat Bank Research tapes post-1972. “

#### **IV. Summary Measures**

This section presents an overview of four summary measures of banking-system structure and performance that are of interest to our study. First, safety net provision in each country is discussed and informally quantified in terms of the willingness of regulators to tolerate bank failures.

Second, market capital (MCAP) and book capital (BCAP) ratios

are estimated to set the stage for the capital-structure regressions. Book equity value (BVE) and book asset value (BVA) are derived from the accounting (balance sheet) data. Book capital (BCAP) ratios were calculated as  $BVE/BVA$ , and BVE values were replaced by MVE values to form market capital ratios (MCAP). Market values of equity (MVE) are calculated as stock price times number of shares.

Third, bank equity and asset volatility measures are estimated. Equity volatility estimates ( $\sigma_E$ ) were derived from the weekly stock price data. Asset volatilities were derived by "deleveraging"  $\sigma_E$  through the formula  $\sigma_A = \sigma_E$  times MCAP.

Finally, bank charter values are estimated. Charter values were estimated in two ways: first as the market to book value of equity ( $MVE/BVE$ ) and second as the market value to book value of assets  $[(MVE+BVL)/ASSETS]$ , where BVL equals BVA minus BVE.

#### **IV:A. Safety Net Support**

As discussed above, safety-net provision has sharply increased in each country over the past 100 years. The founding of the Federal Reserve System in 1914 and creation of the Bank of Canada in 1935 date formal central bank functions in these countries. In contrast, the Bank of England had begun to develop central bank functions at least a century prior to these dates.

Safety-net guarantees are difficult to quantify, since they are often implicit and discretionary. Instead, we employ an indirect measure, in terms of the willingness of regulators to

tolerate bank failures and depositor losses. Stronger safety net guarantees should reduce bank failures and lower depositor losses. Since failure and loss rates also reflect economic conditions and other variables, it is necessary to infer safety-net support through comparisons over time periods that include several business cycles.

Figure 1 graphs annual historical bank failure rates (number of bank failures by the number of banks, expressed in basis points) for the U.S. Five periods stand out on the graph. First, the pre-1920s period shows a roughly constant bank failure rate of 39.8 bp. During the 1920s, failure rates increased dramatically, particularly in agriculturally-depressed regions, which pre-dated the heightened failure rates during the early 1930s. The annual failure rate peaked at 27.1 percent in 1933. A further recession occurred during 1937-38. Post-1930s, failure rates dropped to historically minuscule levels after the introduction of federal deposit insurance and strengthened regulation and supervision. Finally, bank failure rates rose again in the 1980s.

Figure 2 graphs bank numbers in the Canadian banking system covering 1879-1990. At its peak in 1879 the number of banks operating in Canada was 48. A steady decline in bank numbers, mostly through consolidations, resulted in only 10 chartered banks by 1932. From 1860 through 1920, a total of 26 bank failures occurred, with the Home Bank in 1923 the last significant bank failure in Canada. The decade-by-decade distribution of bank failures is as follows.

		Decade				
<u>1860s</u>	<u>70s</u>	<u>80s</u>	<u>90s</u>	<u>1900s</u>	<u>10s</u>	<u>20s</u>
1868	1873	1881	1893	1905	1910(2)	1923
	1876	1883	1895	1906	1914	
	1879(4)	1887(4)	1899	1908(3)		
		1888				

Over the period 1879 through 1929, the average bank failure rate was 132.3 bp, with a loss rate on bank liabilities (including bank notes) of 4.7 bp. This failure rate is well above that for the pre-1920s U.S. The absence of bank failures in Canada since the early 1920s reflects both bank consolidations and the increased bank safety net guarantees from the 1920s onward.

Finally, figure 3 graphs the consolidation among UK "primary" banks over the period: 1890-1990. Much as with Canada, bank numbers showed a steady but slower decline until the 1970s. Over this period, there have been a total of 7 recorded "primary" bank failures among London-based UK and provincial banks<sup>2</sup>.

No data is available on depositor losses. These 7 bank failures yield an average bank failure rate of 24.3 bp, over the period 1890-1929, which is lower in comparison to the pre-1920s U.S. experience. Note that many UK banks over this period specialized in lending geographically, e.g., the Anglo-Argentine Bank, Ltd., the Bank of Australasia, or the Bank of British West Africa, Ltd.

The bank failure data allow some broad conclusions. First, loss rates declined sharply in Canada and the UK in the first two

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These seven primary bank failures include (1) English Bank of the River Platte in 1891, (2) New Oriental Bank Corporation in 1892, (3) Chartered Mercantile Bank of India, London and China in 1892, (4) English, Sottish and Australian Bank in 1893, (5) London Bank of Australia in 1893, (6) Bank of Egypt in 1911 and (7) Delhi and London Bank in 1924.

decades of the nineteenth century. This was associated with banking-sector consolidations in both Canada and the UK, and with strengthened implicit safety net support schemes. In comparison, the U.S. tolerated high failure rates over a longer period of time. The high bank failure rates of the U.S. in the 1980s also stand out against the relatively low failure experience of Canada and the UK over the same period.

#### IV.B. Capital Ratios

Figures 4A:4C display cross-sectional average book and market capital ratios for the UK, Canada and the U.S. bank samples, respectively. These three plots serve to underscore the importance of the regulatory environment on bank capital structure decisions.

Figures 4A and 4B reveal that both the UK and Canada have experienced long-run declines in both market and book capital ratios, particularly over the pre-1950s period. In the UK, capital ratios declined from highs of approximately 25% book and 25% market values in the 1890s to lows of approximately 5% in the early 1940s. In Canada, capital ratios declined from approximately 15% book value and 20% market value in the 1890s to approximately 4% book and market values in the late 1940s.

In contrast, historical changes in U.S. capital ratios were as much cyclical as secular prior to the 1960s. Peak capital ratios of 12% book and 23% market were realized in the early 1900s, subsequently declining during WWI and the recession that followed. Capital ratios increased again during the 1920s to highs of 12%

book and 25% market capital ratios, followed by a further decline during the 1930s and 1940s. Market ratios in particular recovered in the 1960s to a high of 15%. Further declines in capital ratios start to become apparent around the mid 1960s and early 1970s.

Overall, the results in figure 4 suggest that more consolidated banking structures result in lower capital ratios.

#### IV.C. Volatility Measures

This section investigates measures of implied bank-portfolio asset risk and bank equity volatility. Figures 6A:6C present historical volatility estimates for the three countries. The equity volatility estimates were generated from the monthly stock price data for the UK and Canada and weekly U.S. bank stock price data. Asset volatilities are then derived from the formula,  $\sigma_A = \sigma_E$  times MCAP, which "deleverages" the equity volatility estimates. The asset-volatility estimates reflect bank allocation in their loan and security portions of their asset portfolios.

The figures suggest that after correcting for capital structure changes, implied asset volatilities in each country show little or no historical trend. The asset volatility highs (lows) realized in the 1930s (early 1980s) were not much different than those in other periods in each country. These figures are consistent with increased "moral-suasion" by bank regulators or increased market discipline that have offset the moral-hazard incentives that accompany increasing safety-net guarantees.

However, the figures also reveal a pattern of increasing

equity volatility over the study period. In the UK, increasing equity volatility has occurred since the 1940s, while in Canada the secular increase dates from the 1910s. Equity volatilities show approximately a 10-fold increase in each country over the period of the study. Given the relatively constant levels of asset volatilities, these trends point to falling capital ratios (increased leverage) as responsible for the increasing levels of bank equity volatility.

#### **IV.D. Charter-Value Measures**

Our fourth set of measures are estimates of bank charter values (see for example Saunders and Wilson, 1996). We would expect charter values to increase as regulatory barriers limit entry of new banks and/or encourage consolidation, giving chartered banks protected lending opportunities and/or access to liability sources at lower rates. The market-value-to-book-value equity ratio (MVBVE), is a commonly-used measure of charter value.

Figures 5A:C display historical values for the MVBVE ratio. The figures also graph book capital ratios to allow the impact of charter value on capital structure decisions to be assessed.

Figure 5A gives charter value estimates for the UK. Note that the time series of charter value estimates were largely cyclical before roughly the 1960s. Historically high charter values occurred during the 1890s and again during the late 1930s. Historically low values occurred during WWI and during and after WWII. As well, note that UK charter values were largely unaffected by the depression in

the 1930s.

Figure 5B plots the times series of charter value estimates for Canada. The graph shows a long period of secular increase in Canadian charter values, lasting until the 1970s. This period coincides with the consolidation and concentration of bank assets that took place in Canada, suggesting that the consolidation in the banking sector produced protected rents for banks. As noted above, Canadian banks came under increasing competition in the 1970s and 1980s with the growth of non-bank and foreign bank competition, and the deregulatory Bank Acts of 1980, 1987 and 1992. This latter period corresponds with the observed steep decline in charter values in Figure 5B.

Finally, Figure 5C graphs historical U.S. charter values. The measures were largely cyclical until U.S. banks realized sharp increases in charter value starting in the 1970s.

These three figures offer preliminary evidence of a mostly negative charter value effect on bank capital ratios. For example, in the UK book capital ratios (BCAP) moved mostly opposite to charter values during the 1920-75 period. In Canada, capital ratios declined over a long period during which charter values were increasing.

## **V. Regression Results**

### **V.A. Cross-sectional regressions**

As an initial test of the relationship between asset risk and bank capital structure, cross-sectional regressions of each bank's



market capital ratio (MCAP) were run on individual bank asset volatilities ( $\sigma_A$ ) for each country for each year. The resulting annual regression estimates - intercepts and slopes - are graphed in Figures 7A:C. The resulting time-series of cross-sectional estimates can then be checked for cyclical and secular trends before pooling the data to perform cross-sectional/time-series regressions.

The annual cross-sectional regressions allow us to decompose bank capital choice into (bank-specific) risk-sensitive and common (non-bank-specific) reserve capital components.<sup>3</sup> The slope estimates reflect that part of bank-capital ratios which are sensitive to individual bank choice of asset risk and other risk factors. In contrast, the intercept estimates represent capital ratio levels insensitive to asset risk and the other risk factors, and that is systemic or common to all banks. One possible rationale for this second component is that banks held "reserve" capital levels to protect against system-wide crises or economic shocks.

Figures 7A:C graph the resulting cross-sectional regression estimates. Plots for all three countries show a common pattern. First, the slope estimates of the risk-sensitive capital component vary considerably, and range in value from approximately 0.5% to almost 4.0% capital ratio (MCAP) increase per unit increase of asset risk. Also, these estimates show little secular or cyclical trend over the study period, e.g., capital ratios were approximately as risk-sensitive in the 1890s as in the 1990s.

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See Appendix A for details of regression specification.

In contrast, the cross-sectional intercept estimates show strong secular declines over the study period. In the late 1800s, banks held approximately 10% to 14% capital (on average) in the form of capital unrelated to bank-specific asset risk. This capital component had declined to approximately 3% by the 1990s, which is consistent with the expansion of explicit and implicit safety net guarantees, and a secular reduction in the perception of systemic risk exposure on the part of banks over the same period.

#### **V.B. Panel Regression Results**

Preliminary panel regression results are presented in Tables IA:C. Note that the regressions are structured in a "leverage" format, with  $\log(1-\text{MCAP})$  or leverage as the dependent variable, and with the charter value measure, MVBVA, included in log form. The rationale for this econometric specification is presented in Appendix A.

The panel regression results mostly confirm the preliminary conclusions made in the previous sections. First, asset volatilities are mostly negatively related to log leverage. The second-order effect of asset volatility on bank leverage is generally significant and positive, indicating that the volatility effect is convex, i.e., leverage decreases at a decreasing rate with increasing asset volatility. Note that the regression estimates do not appear to show a secular (declining or increasing) trend.

The tests of charter value effects are given in the last panel

of Tables IA:C. The charter value variable is often significant, but varies in sign. With UK banks, the estimate is significant and positive in 3 of the 5 subperiods, implying that in these subperiods banks with higher charter values were on average more leveraged, i.e., held lower capital ratios. With Canadian banks, the estimates always show a positive association between charter values and leverage when the test is significant. With U.S. banks, the estimates are significant and positive in four subperiods, and significant and negative in one subperiod. Overall, the tests suggest that if anything capital ratios have been inversely related to bank charter values in these three countries over long periods of time. One possible explanation is that banking-sector consolidations produced large branched banks which were better able to diversify risk. This diversification may have served as a substitute for bank capital otherwise required as an insolvency protection mechanism.

Finally, the intercept estimates indicate a secular increase in leverage, i.e., declining overall capital levels, over the 100-year period, which is not accounted for by the study's control variables. The largest part of this decline occurred within the first three sub-periods of the study.

## **VI. Conclusions**

Our analysis has focused on the capital structure decisions of a sample of banks in the UK, Canada and the U.S. over a 100 period. There has been a dearth of information about relative historical

banking performance in structurally diverse banking systems, making our comparative analysis of three major developed countries relatively unique.

Our analysis points to several conclusions. First, safety net provision appears to have had a major impact on bank capital ratios. Canada and the UK realized sharp capital declines by the 1920s. In Canada, bank consolidation and inter-bank assistance reduced bank failures. In England, Bank of England and lifeboat support strengthened over this period, as did bank consolidations. In contrast, the U.S. over this period had a diffuse system of mostly small banks, a fragmented regulatory system, and a relatively weak safety net. Perhaps as a consequence, bank failures and panics were relatively more common in the U.S.

The declines in UK and Canadian bank capital ratios long predate the adoption of explicit deposit insurance in either country. As well, the secular decline in U.S. bank capital ratios post-dates the adoption of U.S. explicit deposit insurance by several decades. The results suggest that implicit safety net guarantees may be more important determinants of capital ratios than explicit guarantees, such as deposit insurance schemes.

Our analysis also indicates that, despite regulatory and bank structure differences, the level of risk-sensitive capital has been roughly comparable, both across time and across countries. Interestingly, capital ratios in all three countries were found to be as asset risk-sensitive in the 1990s as they were in the 1890s. More importantly, the secular capital decline observed in each

country occurred mostly in terms of the capital component unrelated to the bank-specific risk factors, i.e., in that component of capital held in common by all banks within a country.

Evidence of the role of charter values is somewhat mixed. Charter value estimates were historically mostly higher in the U.S. than Canada, despite greater banking concentration in Canada. UK banks generally had higher charter values than either Canada or the U.S. Our regression results indicate overall that banks with greater charter value hold lower, rather than higher, capital ratios. This may occur because higher charter value banks are better diversified, e.g., through product or geographic expansion, and therefore require less capital.

Finally, bank equity volatility has increased dramatically in each of the three countries, along with the decline in bank capital ratios. This combination of increased equity volatility and lower capital ratios may explain the banking-sector instability observed in the 1980s, particularly in the U.S. Interestingly, asset volatility in contrast has shown little trend over the study period in each country. This may indicate that increasing safety net guarantees have not induced banks to increase risk-taking levels, as might be suggested by moral hazard considerations.

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## TABLE IA: CAPITAL STRUCTURE REGRESSIONS

## UK Money Center Banks

Time-Series Cross-Sectional Regressions:  $\log(1-\text{MCAP})$ 

Term 1893-1914 1915-1939 1940-1957 1958-1972 1973-1992

R<sup>2</sup> 0.673 0.289 0.937 0.747 0.831

SS 456 329 111 92 134

Const -.598\*\*\* -.380\*\*\* -.221\*\*\* -.0401\*\*\* -0.174\*\*

## ECONOMIC CONTROL VARIABLES

STOCK 0.059\*\* -.002 , -.0024 0.00657\*\*\* -.00729

BOND 0.019 0.007 -.0020 -.0090\*\*\* -.00068

BILL 0.0025 -.003 0.0003 0.0046\*\*\* -.0034\*

LNBVA 0.0285\*\*\* -.0155\*\*\* 0.0099\*\*\* 0.0015 0.0071\*\*\*

ASSET VOLATILITY:  $\sigma_A$ 

$\sigma_A$  -.0274\*\* -.00079\*\* -.0031\*\* -.00450\*\*\* -.0090\*\*

$\sigma_A^2$  0.0040\* 0.00026\*\* -.0239\* 0.000246\*\* 0.00041\*

CHARTER VALUE TEST:  $\beta_{\log(q)} = 0$  †

0.1038\*\*\* 0.691\*\*\* -.0967\*\*\* 0.3029\*\*\* -.5949\*\*\*

10-percent significance level

\*\* 5-percent significance level

\*\*\* 1-percent significance level

† See Appendix I for econometric specification.

## TABLE IB: CAPITAL STRUCTURE REGRESSIONS

## Canadian Banks

Time-Series Cross-Sectional Regressions:  $\log(1-\text{MCAP})$ 

Term	<u>1893-1914</u>	<u>1915-1939</u>	<u>1940-1957</u>	<u>1958-1972</u>	<u>1973-1992</u>
R <sup>2</sup>	0.924	0.679	0.960	0.870	0.887
SS	120	80	93	120	111
Const	-.728***	-.684***	-.0832***	-.163***	-.0802

## ECONOMIC CONTROL VARIABLES

STOCK		0.0809**	0.00208	0.00898	-.0050
BOND		0.0361*	0.0072**	0.0020**	0.0026***
BILL		-.0019	-.0019	0.0024**	-.0007
LNBVA	.0413***	0.023***	0.0012	0.0045***	0.0014**

ASSET VOLATILITY:  $\sigma_A$ 

$\sigma_A$	-.0070**	-.0137**	-.0205***	-.0128**	-.0128**
$\sigma_A^2$	0.0022	0.0011	0.0028***	0.0026	0.00083***

CHARTER VALUE TEST:  $\beta_{\log(q)} = 0$ 

CAN	0.435***	-.281	0.189***	0.0301	0.1487***
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\* 10-percent significance level

\*\* 5-percent significance level

\*\*\* 1-percent significance level

## TABLE IC: CAPITAL STRUCTURE REGRESSIONS

## U.S. Banks

Time-Series Cross-Sectional Regressions:  $\log(1-\text{MCAP})$ 

<u>Term</u>	<u>1893-1914</u>	<u>1915-1939</u>	<u>1940-1957</u>	<u>1958-1972</u>	<u>1973-1992</u>
R <sup>2</sup>	0.655	0.739	0.429	0.658	0.851
SS	1490	783	228	1081	1254
Const	-.386***	-.3491***	-.0764***	-.2168***	-.1275***

## ECONOMIC CONTROL VARIABLES

STOCK	0.0408***	0.0212*	-.0661***	0.0273	-.0005
BOND	0.1058**	0.0178	0.4032***	0.2092***	-.0087**
BILL	-1.003***	-.3214***	1.335	0.6286***	0.0956***
LNBVA	0.0162***	0.0144**	0.0019	0.0059***	0.0040***

ASSET VOLATILITY:  $\sigma_A$ 

$\sigma_A$	-.0173**	-.0162**	-.0407***	0.0022	-.00052
$\sigma_A^2$	0.00025***	0.00024***	0.0034***	-.00043***	-.00075***

CHARTER VALUE TEST:  $\beta_{\log(q)} = 0$ 

MVBVA	0.1890***	0.2026***	0.7433***	-.4257***	0.2840***
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\* 10-percent significance level

\*\* 5-percent significance level

\*\*\* 1-percent significance level

### Appendix A: Econometric Approach

Our regression test follows that of Saunders and Wilson (1995). Bank capital structure is measured by the variable, MCAP, defined as the ratio of market equity value (price per share times number of shares) to the sum of market equity value and the book value of debt (deposits and other liabilities). Bank charter value is measured by  $q_A$ : the market-value to book-value asset ratio. Asset volatility  $\sigma_A$  is derived from equity volatility,  $\sigma_E$ . The regression relationship takes the following form.

$$\text{MCAP}_{it} = \sigma_{A,it} \beta_1 + q_{A,it} \beta_2 + X_{lit} \beta_3 + \epsilon_{lit} \quad (\text{A1})$$

where  $I$  = bank  $I$ ,  $I=1, \dots, n$ ,

$t$  = time  $t$ ,  $t=1, \dots, T$ .

In (A1),  $X_{lit}$  is a vector of control variables in a regression of the market capital ratio,  $\text{MCAP}_{it}$ , on asset volatility,  $\sigma_{it}$  and charter value measure,  $q_{A,it}$ . The charter value hypothesis is then tested under the null hypothesis that  $\beta_2=0$  in equation (11).

We next reformulate the regression, as follows. By definition,  $\text{MCAP}_t$  equals  $V_t/(V_t+D_t)$ , where  $V_t$  is the market value of equity and  $D_t$  is the book value of debt. The book capital ratio,  $\text{BCAP}_t$ , is similarly defined except with  $V_t$  replaced by  $W_t$  (the book value of equity). Finally,  $q_A$  equals  $(V_t+D_t)/(W_t+D_t)$ . Given these definitions, the market capital ratio can be re-expressed as follows.

$$\begin{aligned}
\text{MCAP}_t &= V_t / (V_t + D_t) \\
&= [(V_t + D_t - D_t) / (W_t + D_t)] / [(V_t + D_t) / (W_t + D_t)] \\
&= [q_{A,t} - (1 - \text{BCAP}_t)] / q_{A,t} \\
&= 1 - (1 - \text{BCAP}_t) / q_{A,t} \tag{A2}
\end{aligned}$$

Equation (A2) implies a precise mathematical relationship between  $\text{MCAP}_t$  and  $q_{A,t}$  which also involves the book capital ratio,  $\text{BCAP}_t$ . In particular, all influences on  $\text{MCAP}_t$  are mediated by  $q_{A,t}$  and  $\text{BCAP}_t$ . For example, market value changes impact  $\text{MCAP}$  through  $q_{A,t}$ . In contrast, dividend and capital structure decisions are reflected in  $\text{BCAP}_t$ .

In light of this mathematical relationship, we would expect, a priori, to find a significant regression relationship between  $\text{MCAP}_t$  and  $q_{A,t}$ . To explore this further, the relationship in (A2) is linearized, using the mathematical identity:  $1/(1-x) = (1 + x + x^2 + \dots)$ . This yields the following:

$$\begin{aligned}
\text{MCAP}_t &= 1 - (1 - \text{BCAP}_t) (2 + q_{A,t}) + \epsilon_t \\
&= 2\text{BCAP}_t - 1 + (1 - \text{BCAP}_t) q_{A,t} + \epsilon_t \tag{A3}
\end{aligned}$$

where  $\epsilon_t$  represents higher order terms.

In (A3),  $2\text{BCAP}_t - 1$  corresponds to a regression "intercept" and  $(1 - \text{BCAP}_t)$  to a "slope" coefficient. Therefore, the regression approach in (A1) may lead to spurious conclusions. Two further econometric problems arise. First, (A3) indicates that the intercept and slope parameters should be sensitive to cross-

sectional and time series variation in book capital levels. Second, the null hypothesis that  $\beta_2=0$  in (A1) implies from (A3) that  $BCAP_t=1$ , i.e., that a bank funds its assets only with equity capital. Rejection of this null hypothesis would not be surprising.

A hypothesis of greater interest is whether the capital structure regression in (11) simply reflects the "de facto" mathematical relationship implied in (13), i.e., that  $\beta_2$  equals  $(1-BCAP_t)$ . However, testing this hypothesis is problematic, due to cross-sectional and time series variation in  $BCAP_t$ . Yet, if  $BCAP_t$  is added to the regression analysis, the identity in (12) results.

To circumvent these econometric problems, the specification in (A1) is re-formulated. First, the mathematical identity in (A2) is re-expressed as follows.

$$(1-MCAP_t) = (1-BCAP_t)/q_{A,t} \quad (A4)$$

Taking the (natural) logarithm of both sides of (A4) yields the following identity.

$$\log(1-MCAP_t) = \log(1-BCAP_t) - \log(q_{A,t}) \quad (A5)$$

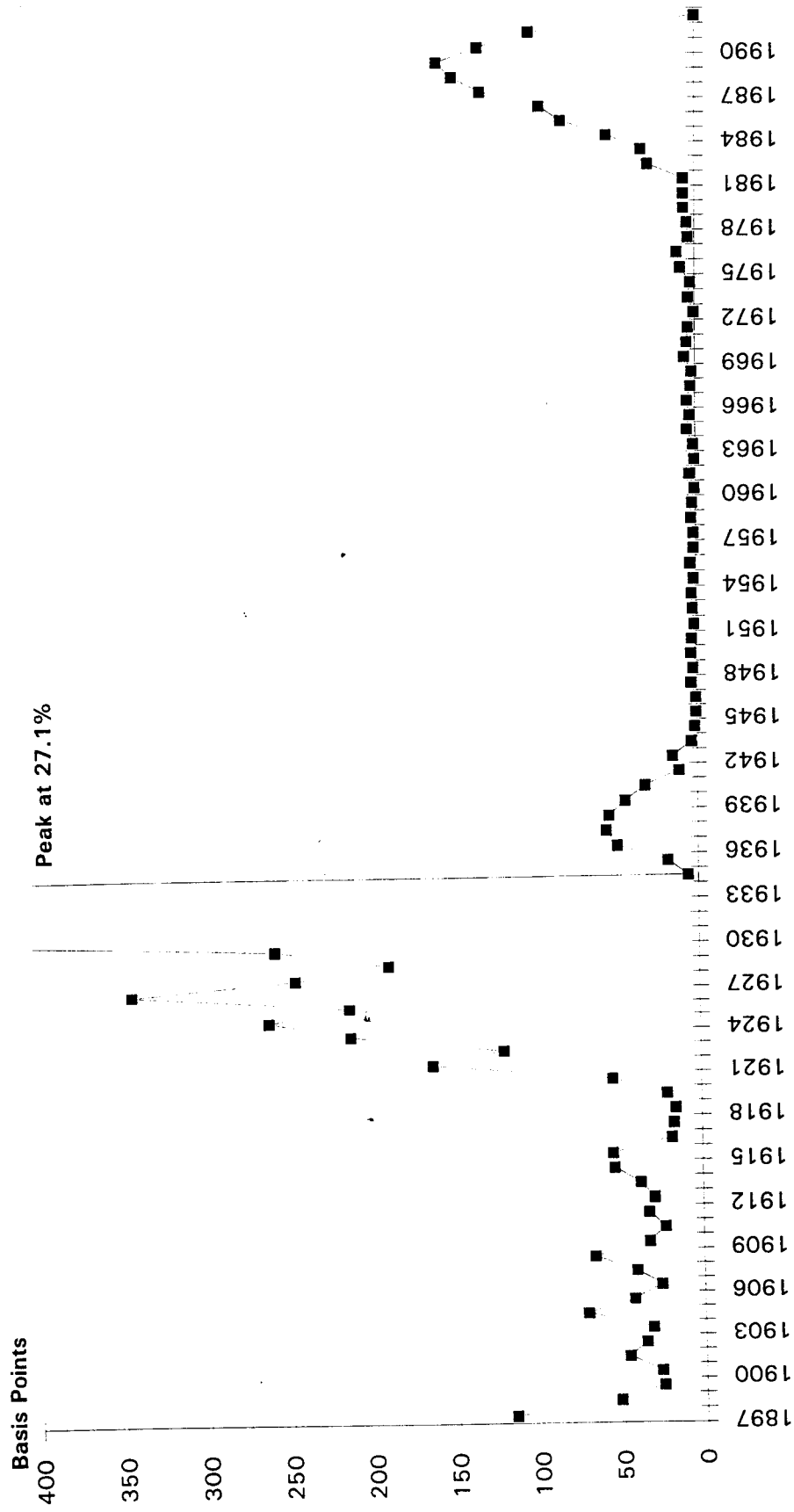
(A5) implies a defacto elasticity of minus unity between the market leverage ratio  $(1-MCAP_t)$  and the charter value measure  $q_{A,t}$ , since  $d[\log(1-MCAP)]/d[\log(q_A)] = [d(1-MCAP)/dq_A] [q_A/(1-MCAP)] = -1$ . Finally, the capital structure regression is re-formulated to follow the structure of equation (A5).



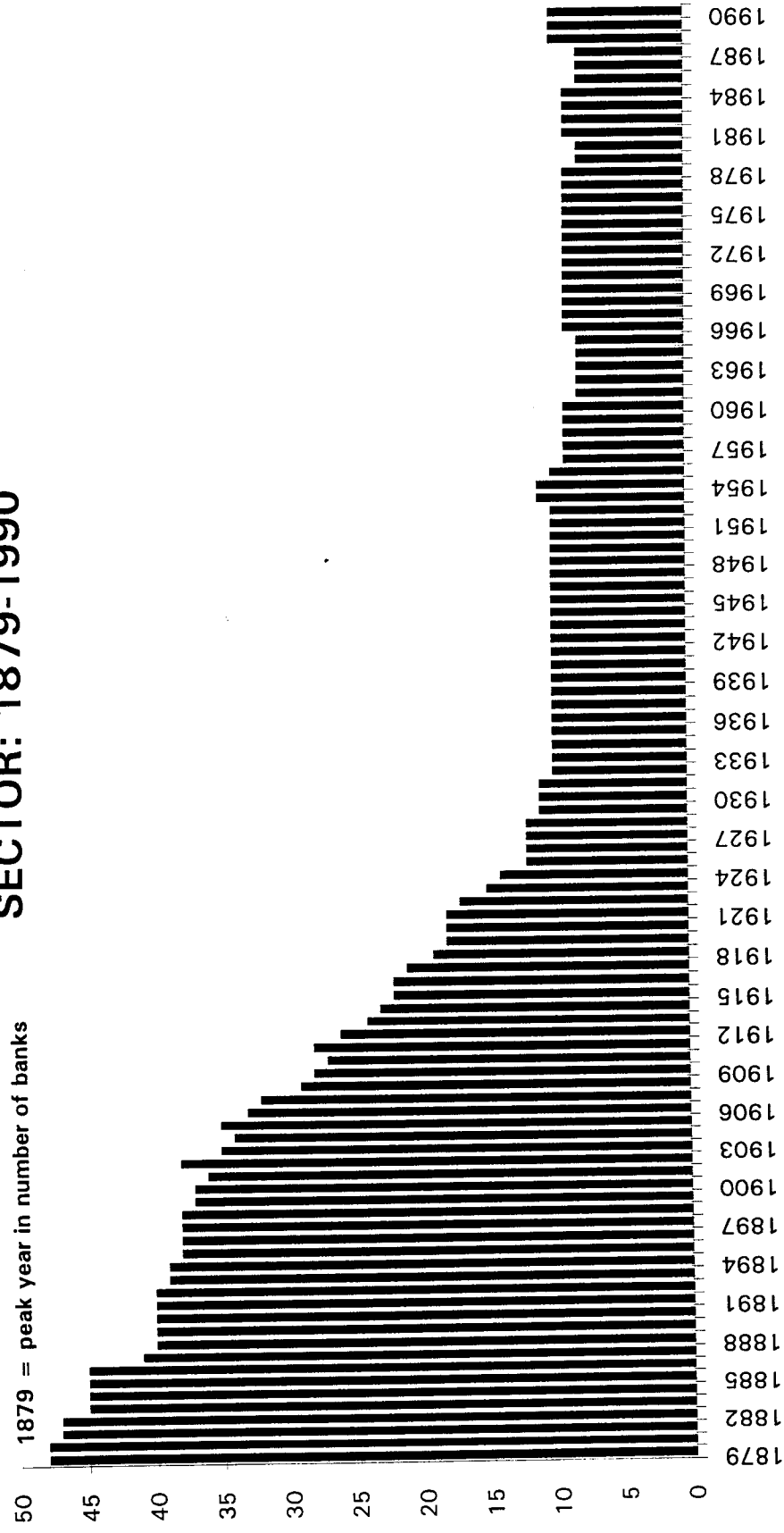
$$\log(1-\text{MCAP}_{it}) = \log(\sigma_{A,it})\beta_1 + (-1+\beta_{\log(q)})\log(q_{A,it}) + X_{2it}\beta_2 + \epsilon_{2it} \quad (\text{A6})$$

In (A6), the null hypothesis:  $\beta_{\log(q)} = 0$  implies that the charter value and market capital ratio relationship merely reflects the mathematical identity given in (A2). In contrast, the alternative hypothesis:  $\beta_{\log(q)} < 0$  supports the charter value hypothesis, i.e., higher charter value banks are actively less leveraged, and implies an elasticity between  $(1-\text{MCAP}_t)$  and  $q_{A,t}$  less than minus unity. Finally, the alternative hypothesis:  $\beta_{\log(q)} > 0$  implies that higher charter value banks hold significantly less capital than expected, i.e., an elasticity greater than minus unity. This conclusion would be consistent with a diversification-based hypothesis that greater charter value allows banks to reduce risk and hold lower capital ratios.

**FIGURE 1: U.S. BANK FAILURE RATE: 1897-1992**



**FIGURE 2: CONSOLIDATION OF THE CANADIAN BANKING  
SECTOR: 1879-1990**



**FIGURE 3: CONSOLIDATION OF THE UK BANKING SECTOR -  
1890-1990**

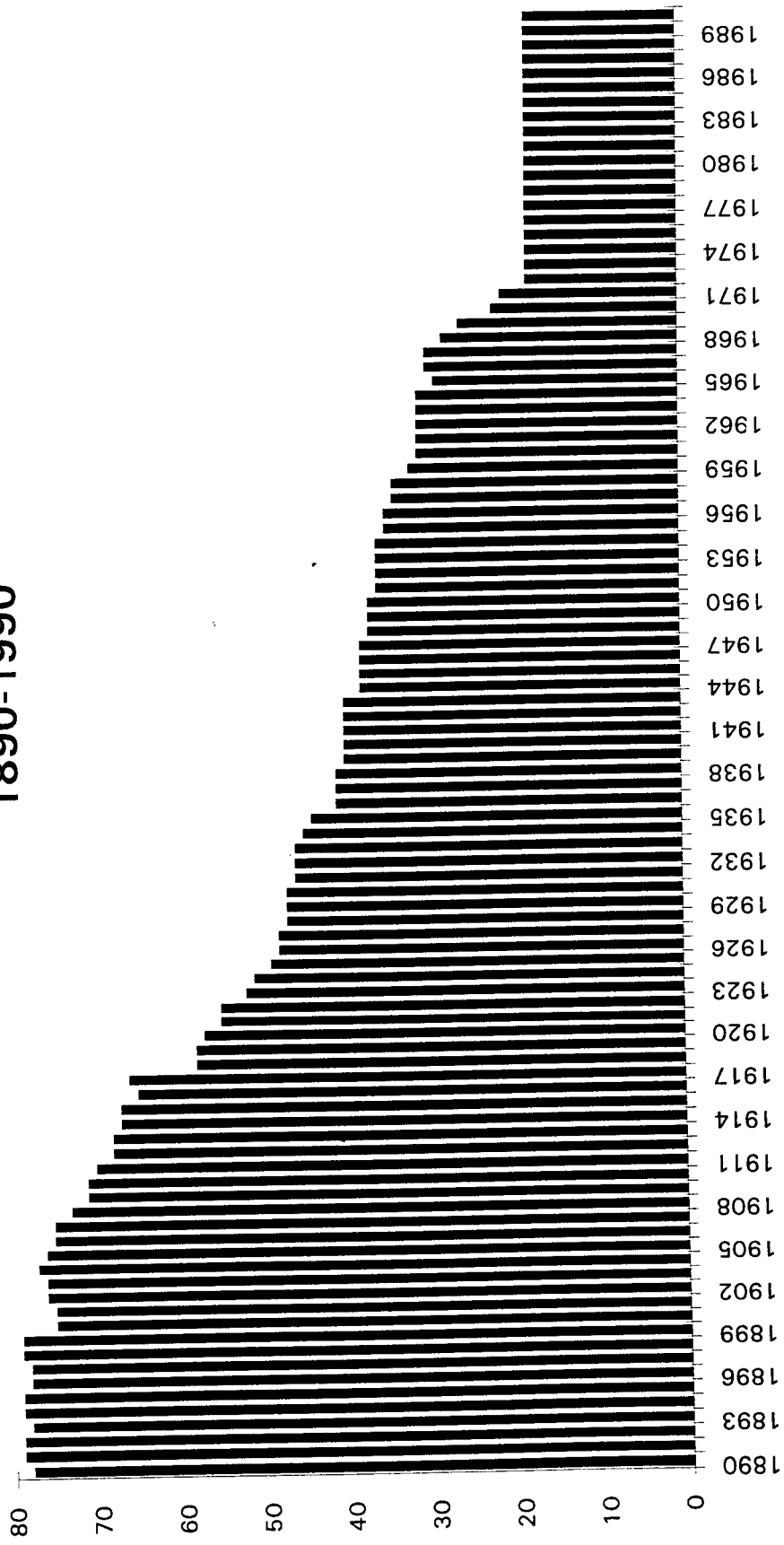
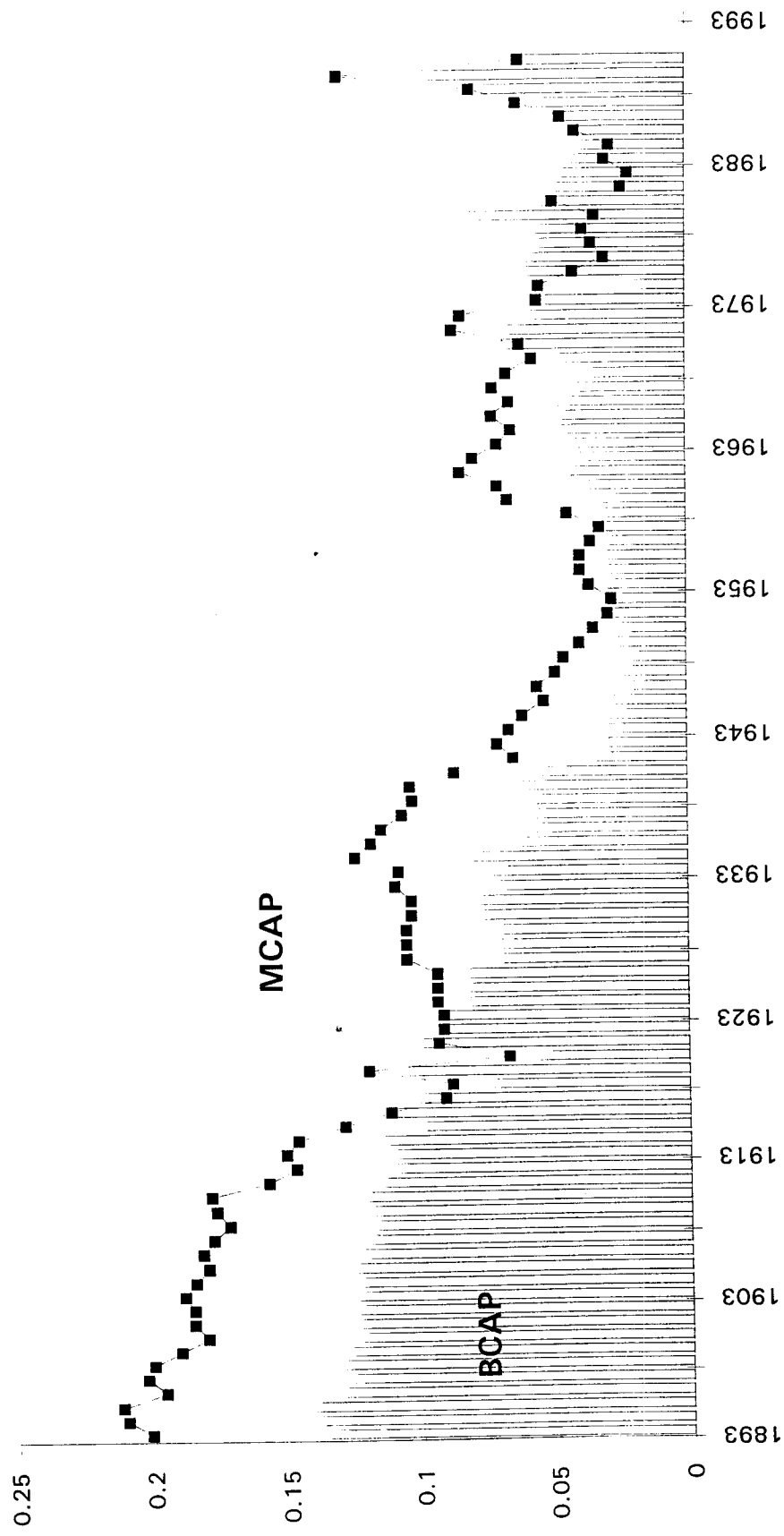


FIG 4A: MARKET AND BOOK CAPITAL RATIOS - UK



**FIGURE 4B: MARKET AND BOOK CAPITAL RATIOS - CANADA**

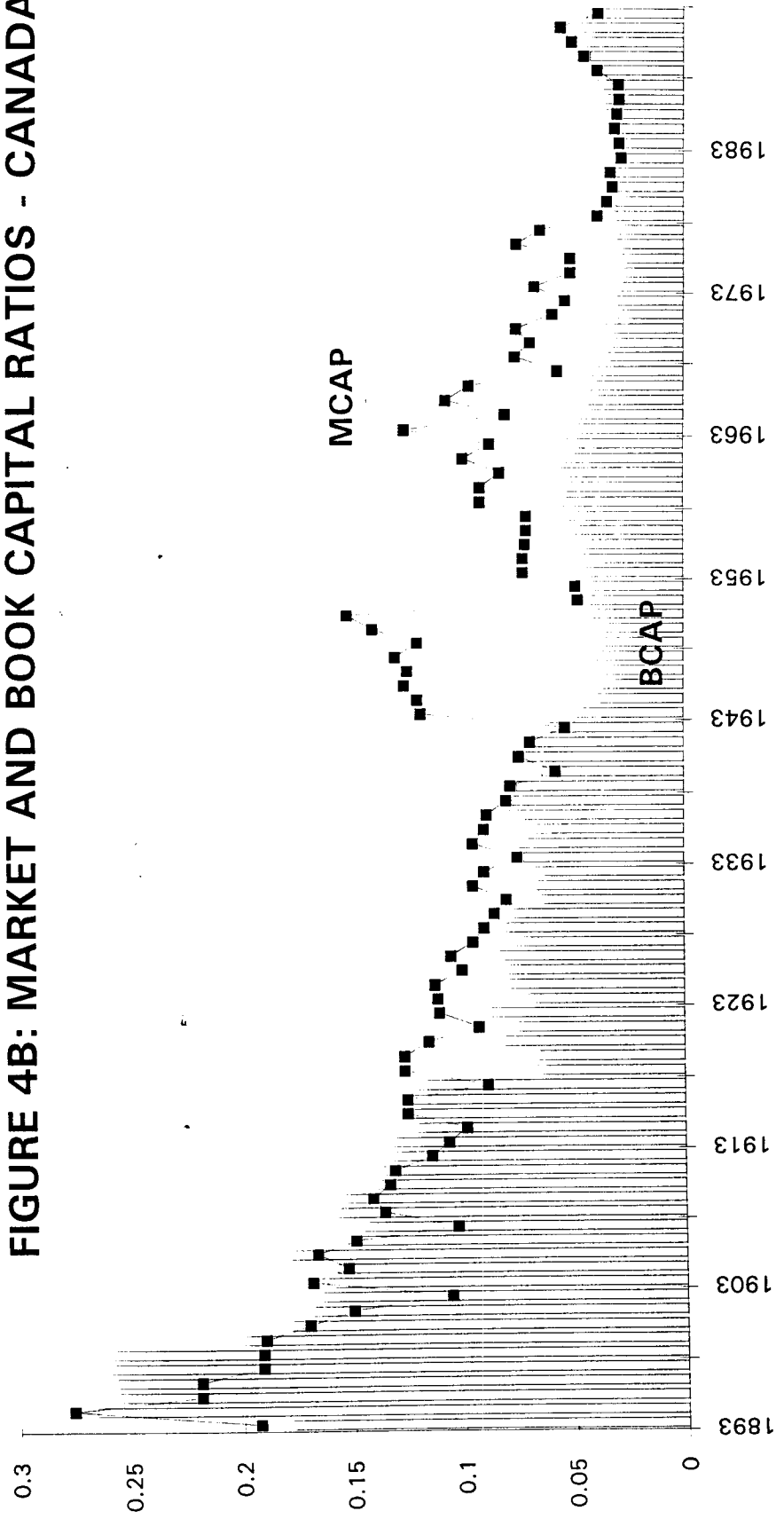


FIG 4C: MARKET AND BOOK CAPITAL RATIOS - U.S.

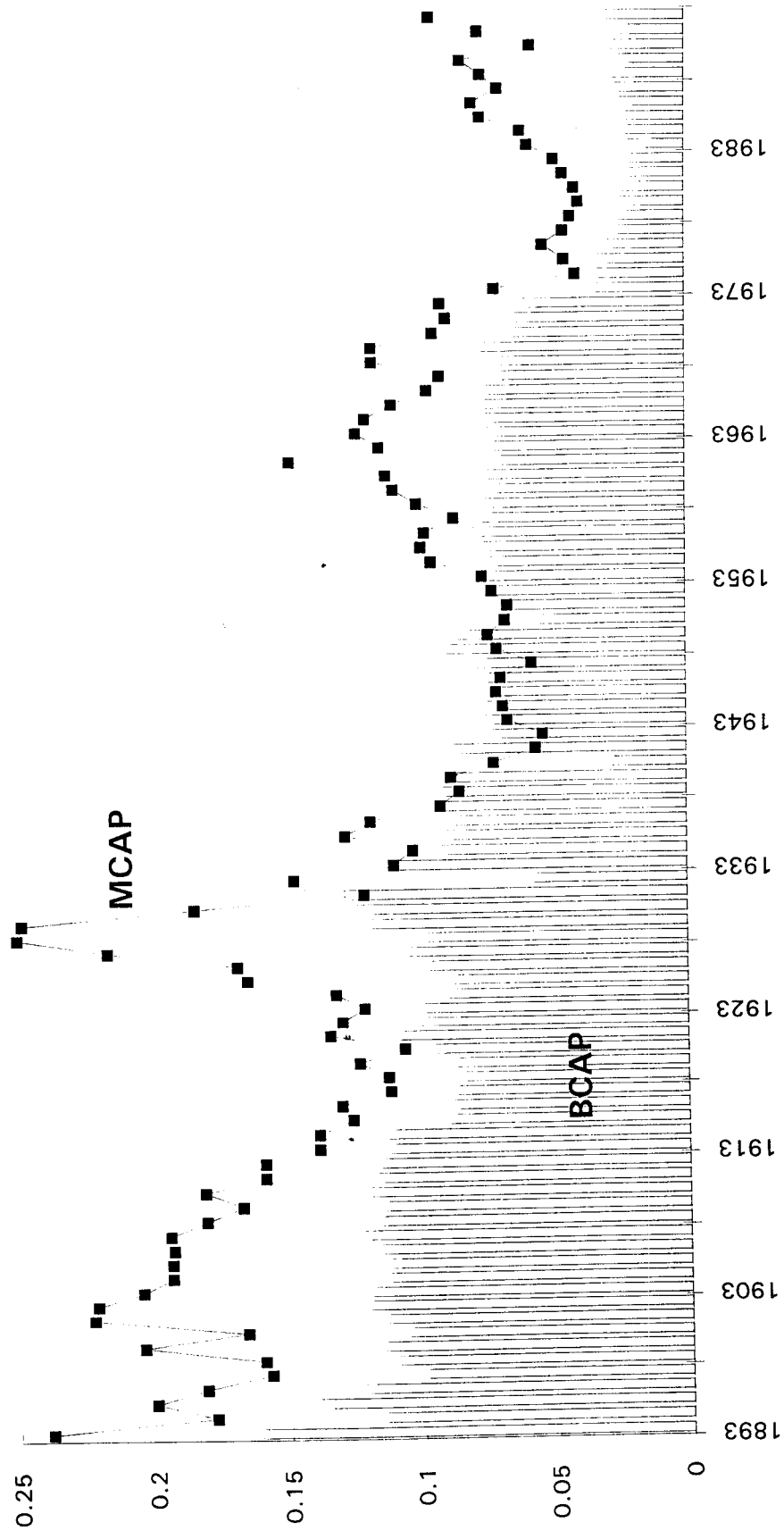
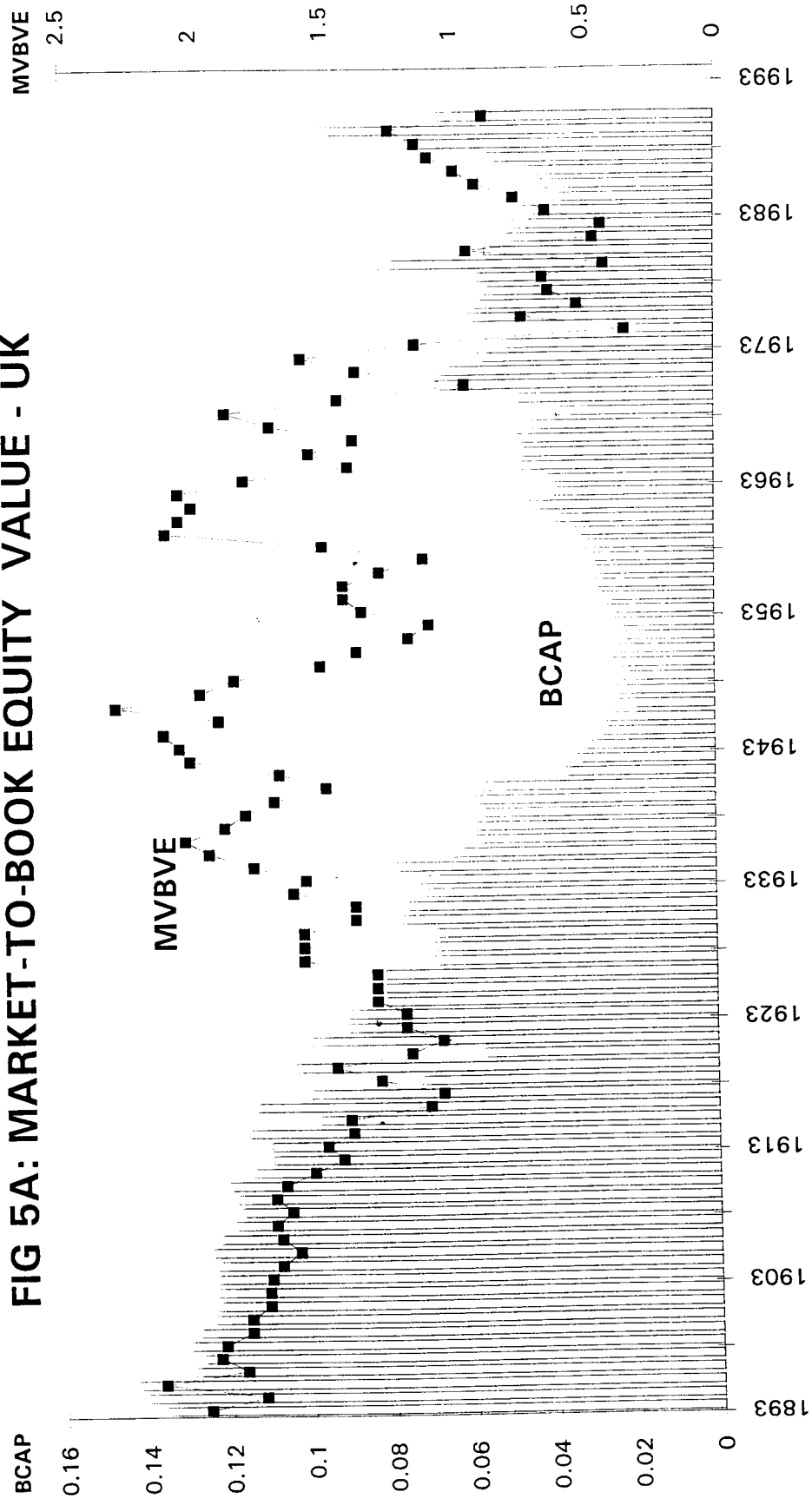
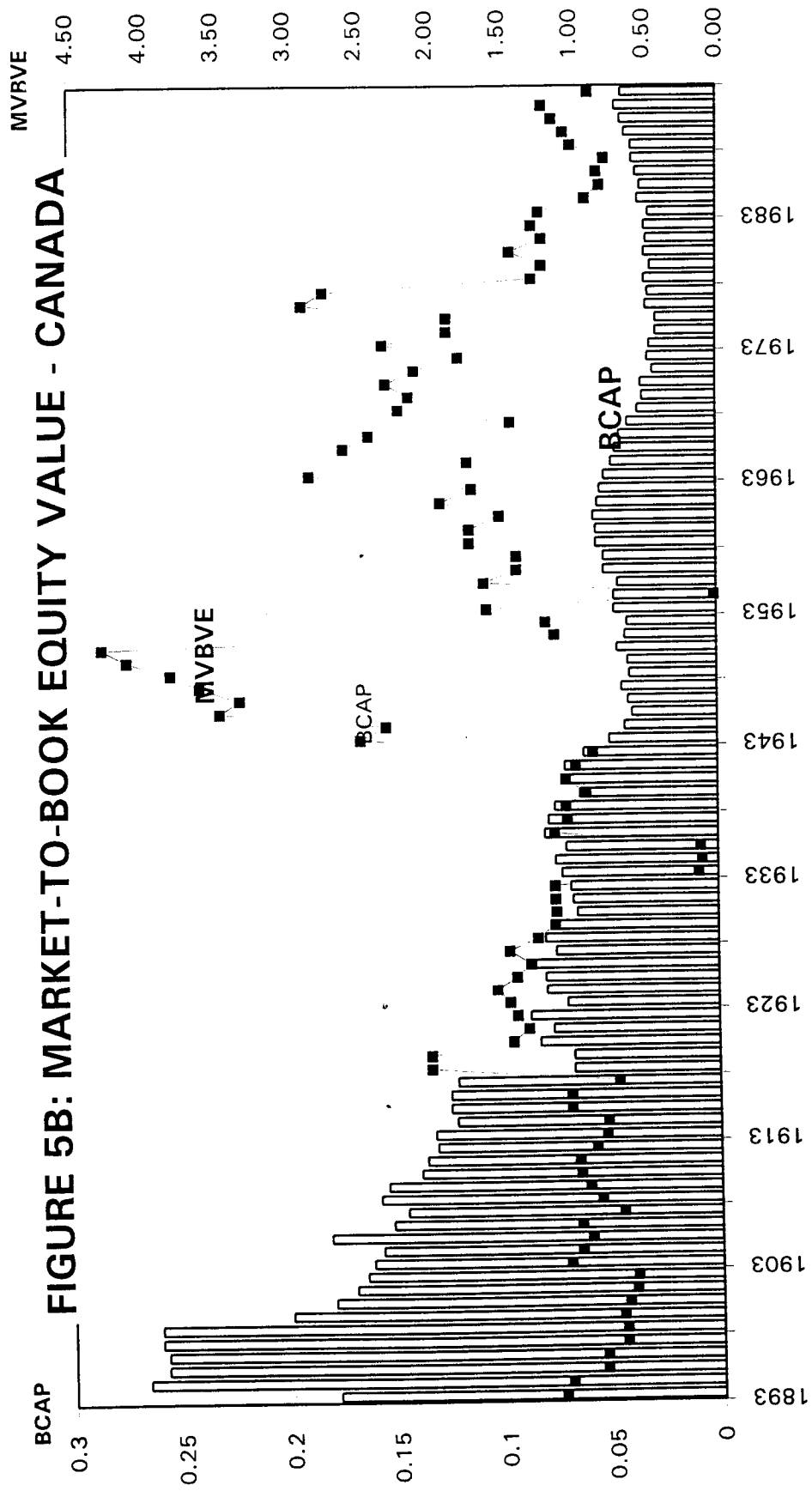


FIG 5A: MARKET-TO-BOOK EQUITY VALUE - UK







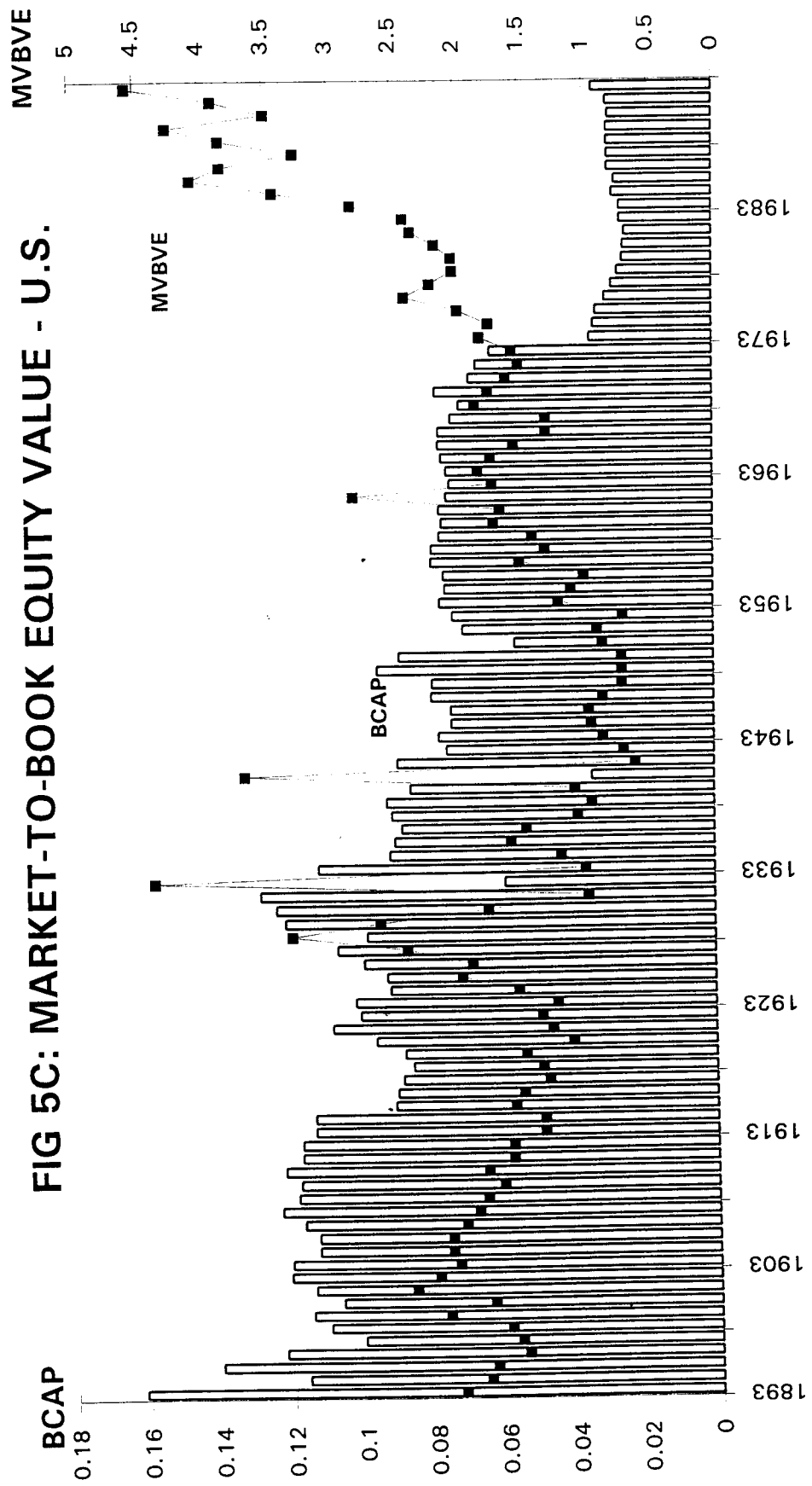


FIG. 6A: EQUITY AND ASSET VOLATILITY - UK

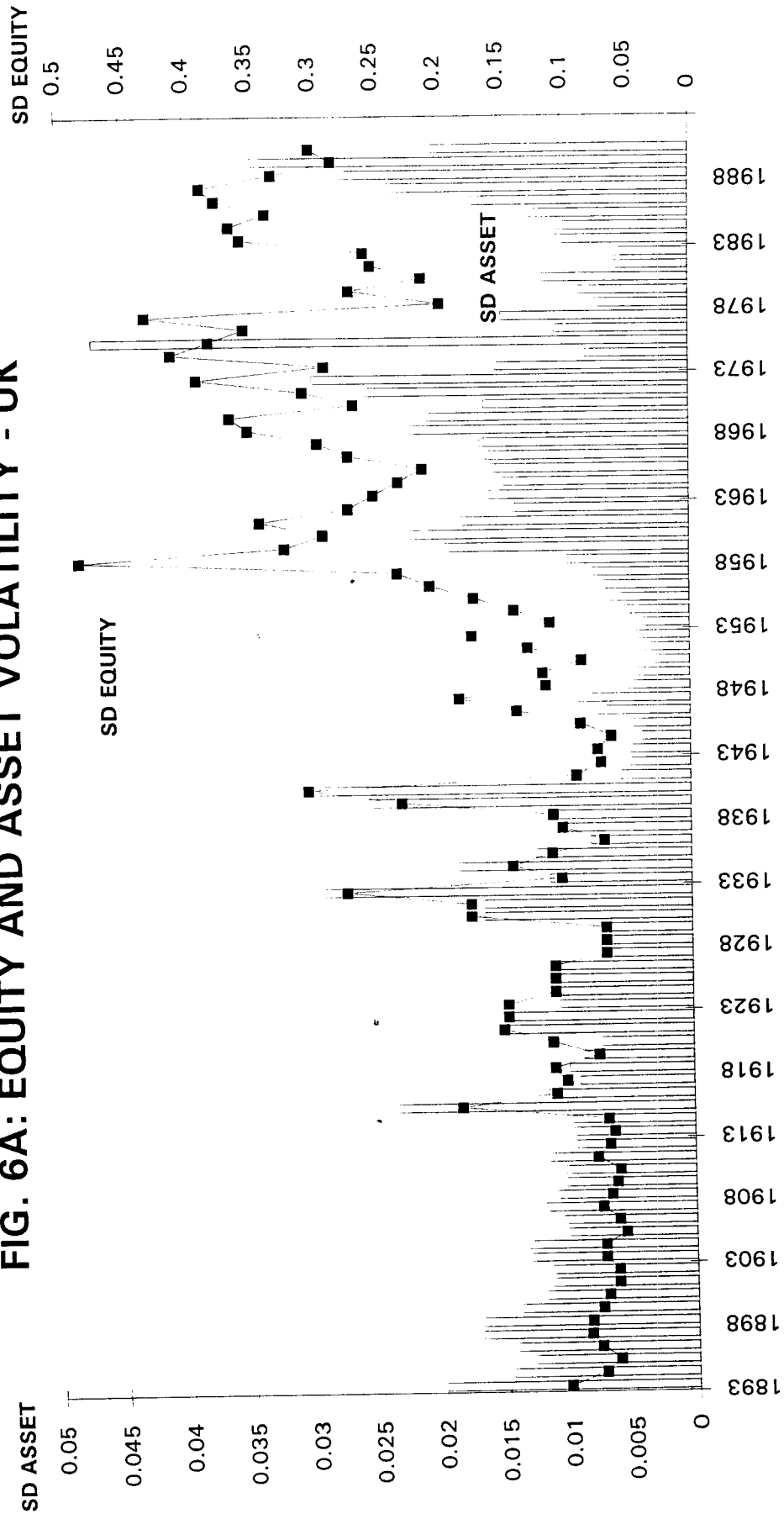
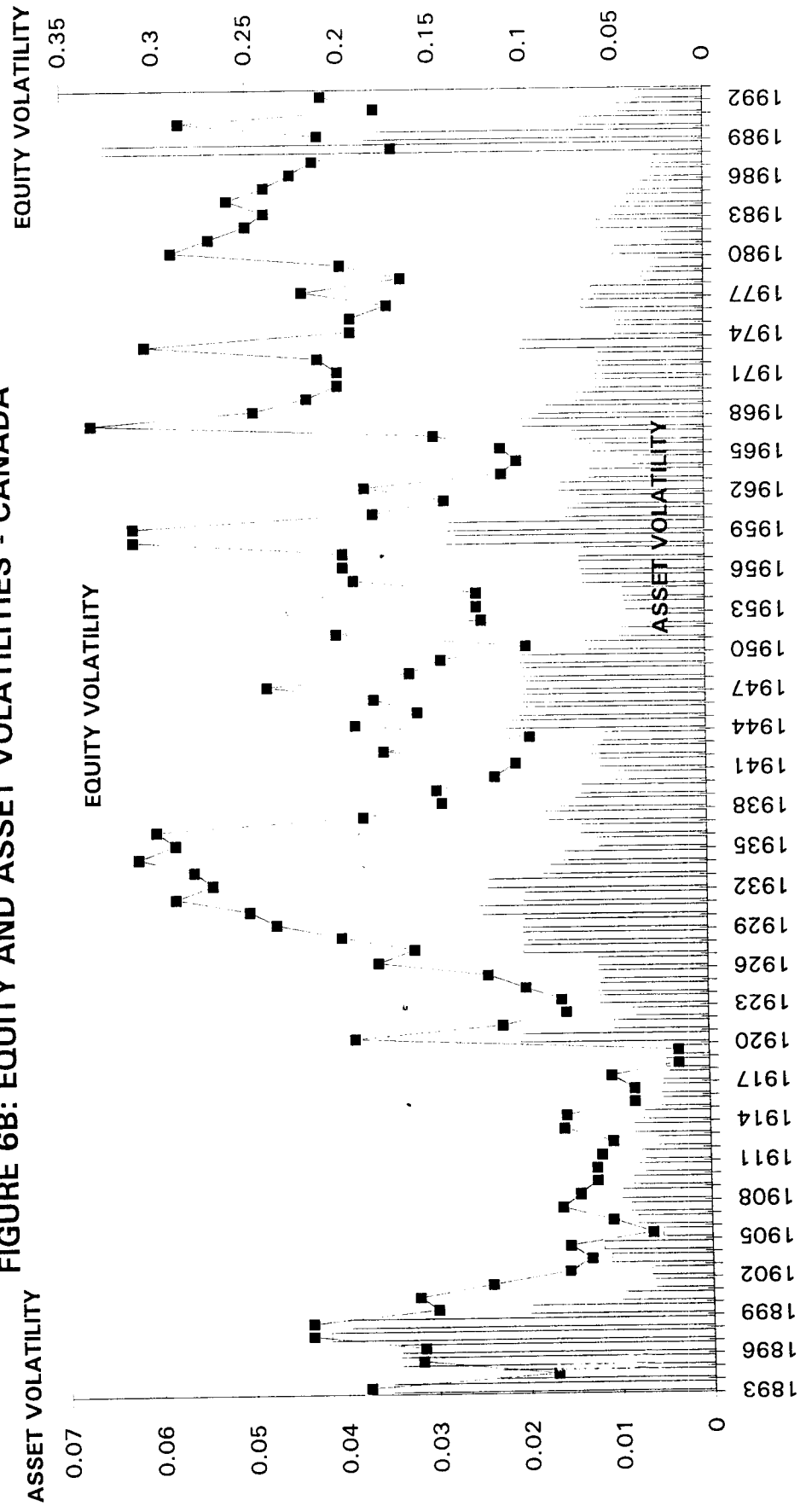


FIGURE 6B: EQUITY AND ASSET VOLATILITIES - CANADA



**FIGURE 6C: EQUITY AND ASSET VOLATILITY - U.S.**

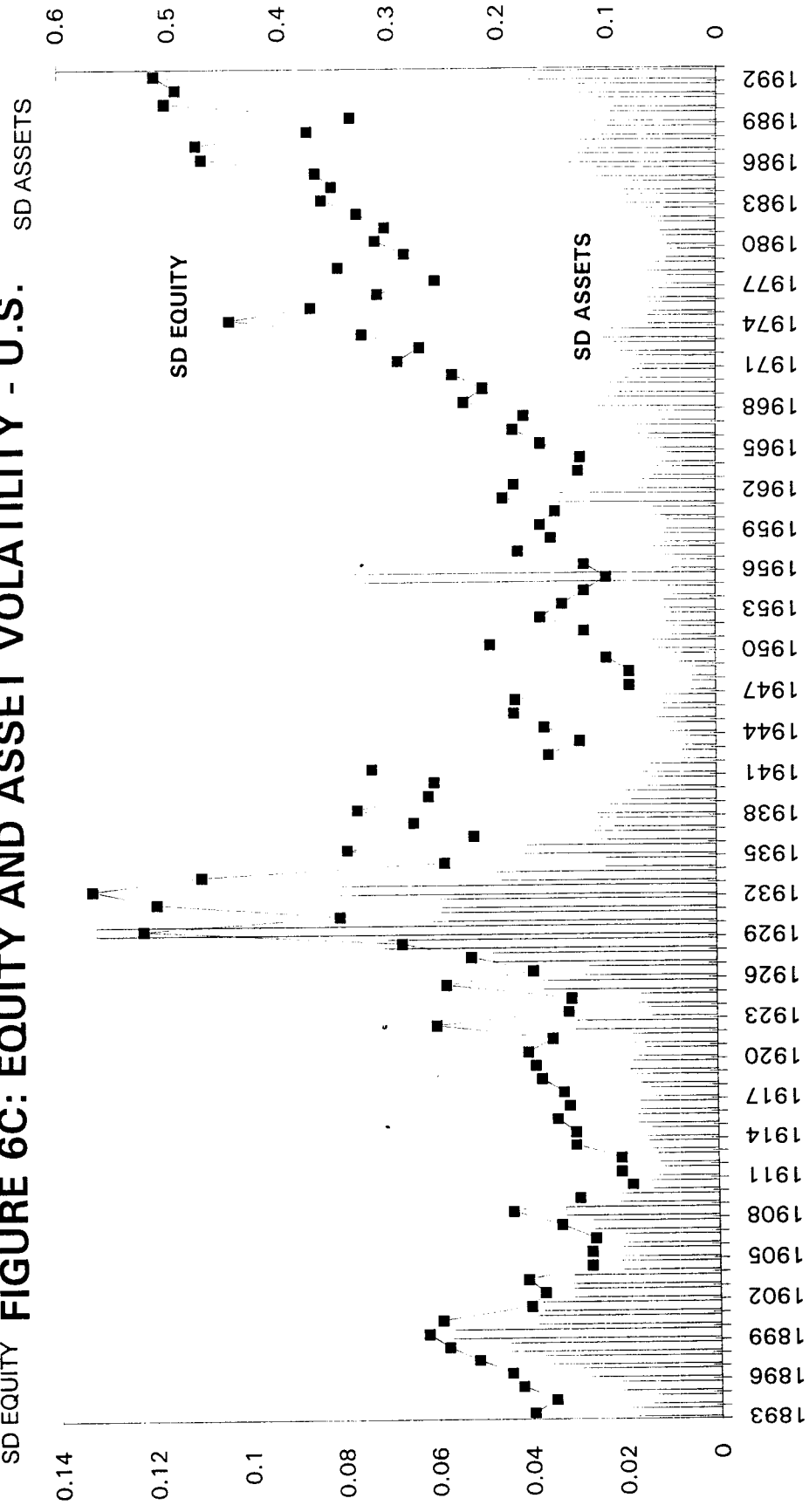
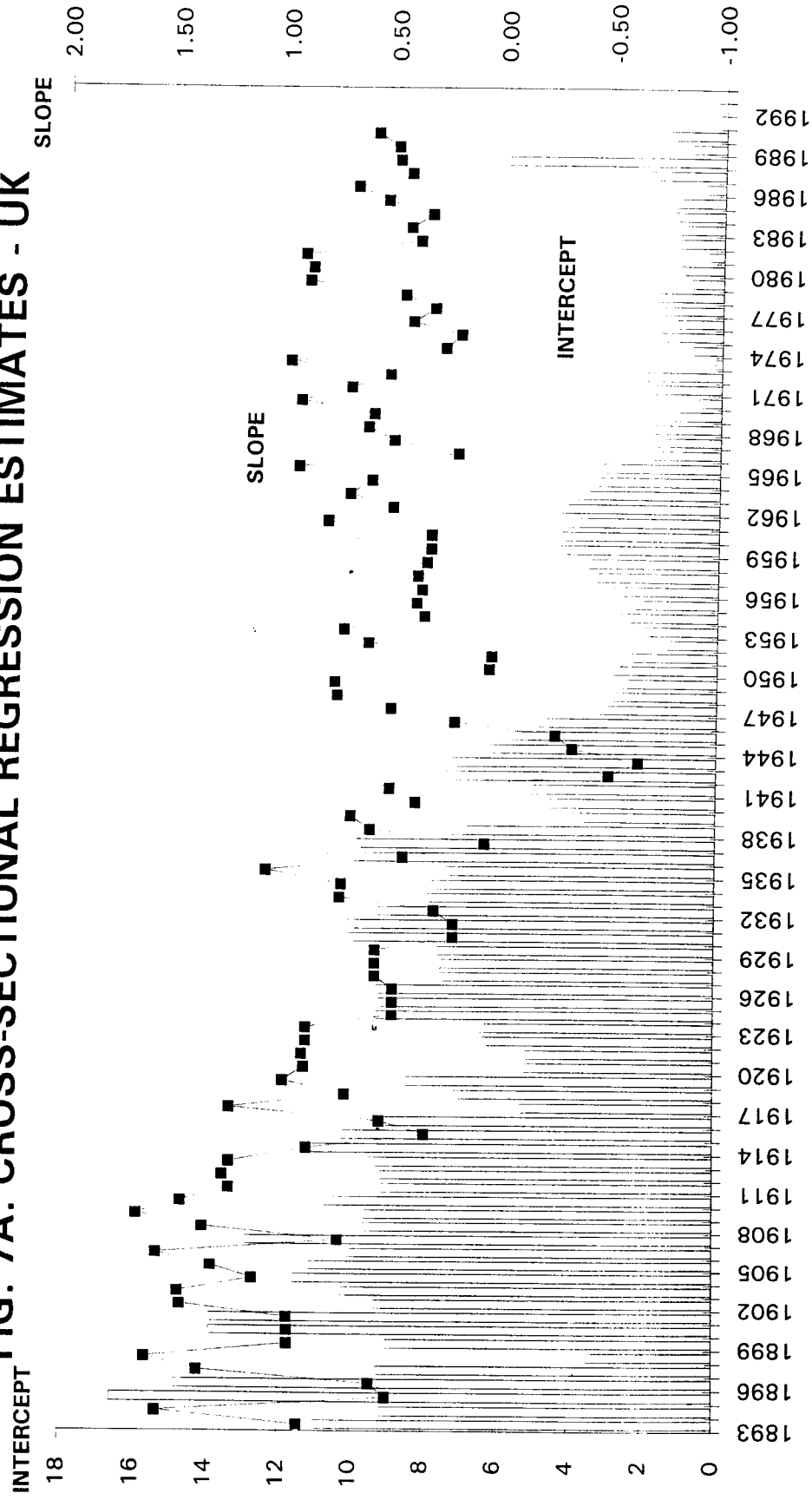
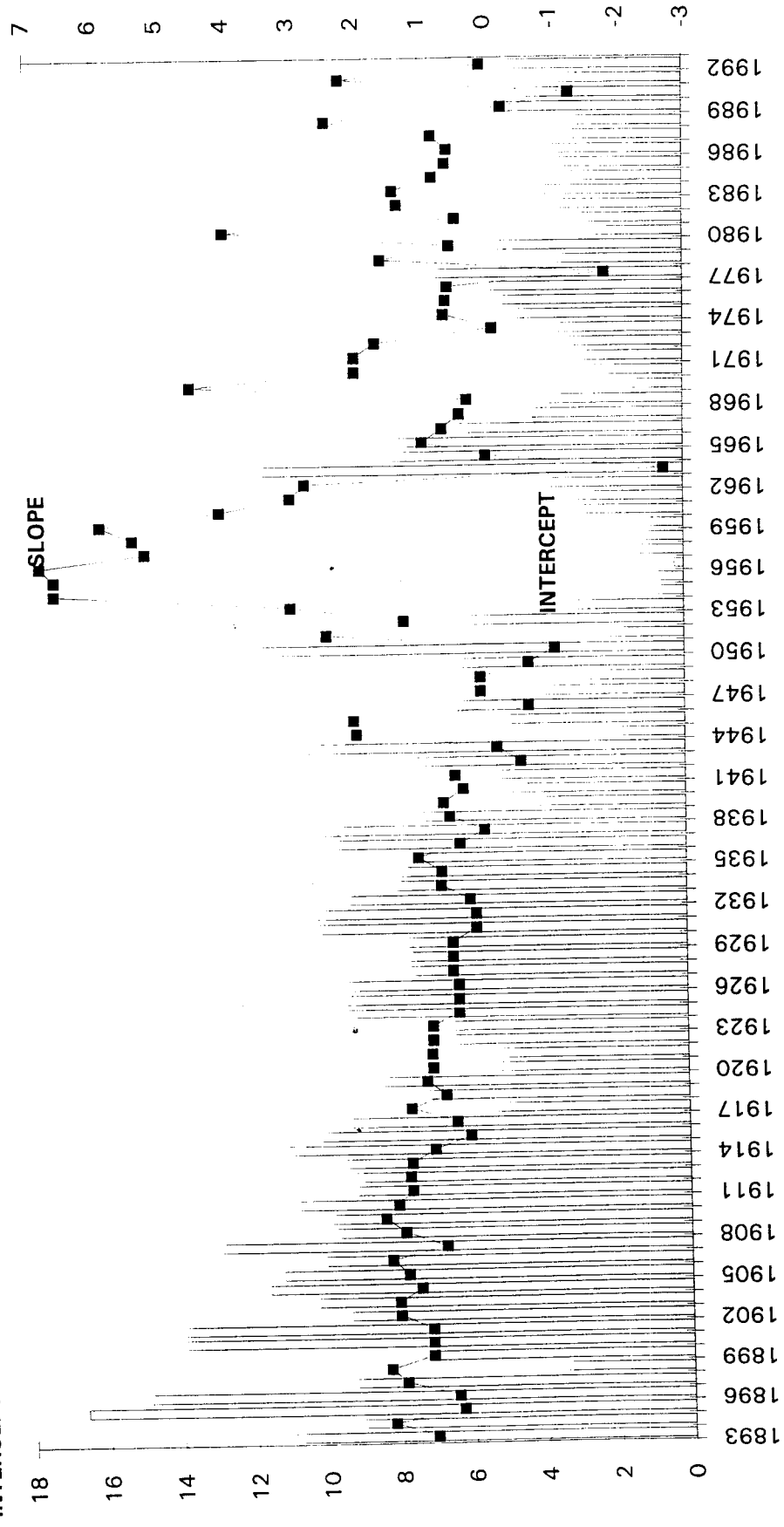


FIG. 7A: CROSS-SECTIONAL REGRESSION ESTIMATES - UK



**FIG 7B: CROSS-SECTIONAL REGRESSION ESTIMATES - CANADA**



**FIG 7C: CROSS-SECTIONAL REGRESSION ESTIMATES - U.S.**

